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ABSTRACT

This study investigated participants' reactions to computerized testing and assessed the practicability of this testing method in the classroom. A sample of 315 secondary-level students took a computerized and a printed version of a standardized aptitude test battery and a survey assessing their reactions to the computerized testing. Overall reactions to the computerized test were positive. Students liked the computerized test for the ease in answering (49 percent), for being "faster" (30 percent), untimed (25 percent), and "fun" (11 percent). The most common complaint involved eye fatigue (32 percent). Girls reported problems and nervousness during the computerized test significantly more frequently than did boys. Overall, students reported that computerized testing can be a workable alternative to printed standardized testing. Administrators' reactions were mixed; examiners were excited about this new mode of test administration but had some difficulty with the planning and logistics of administration. Suggestions for improving computerized testing and the impact of the changing technology are discussed. A copy of the survey questions and excerpts from student surveys are appended. (Author/JAZ)

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Participants' Reactions to Computerized Testing

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Abstract

This study investigated participants' reactions to computerized testing and assessed the practicability of this testing method in the classroom. A sample of 315 secondary-level students took a computerized and a printed version of a standardized aptitude test battery, and a survey assessing their reactions to the computerized testing. Overall reactions to the computerized test were overwhelmingly positive. Students praised the computerized test for the ease in answering (49%), for being "faster" (30%), untimed (25%), and "fun" (11%). The most common complaint involved eye fatigue (32%). Girls reported problems and nervousness during the computerized test significantly more frequently than did boys. Overall, students reported that computerized testing can be a workable alternative to printed standardized testing. Administrators' reactions were mixed; examiners were excited about this new mode of test administration but had some difficulty with the planning and logistics of administration. Suggestions for improving computerized testing and the impact of the changing technology are discussed.

Introduction

This paper addresses participants' reactions to a computerized adaptive ability test. "Computerized adaptive" refers to a test which is administered on an individual basis by a computer. The computer not only displays the test items, it also accepts the examinee's responses to the items, selects items appropriate to the ability of the individual taking the test (based on examinee responses), scores and reports the test results. An excellent detailed description of computerized adaptive testing and how it works is provided by Weiss, 1985.

Over the past decade, computerized adaptive testing has moved from the experimental arena done in connection with the military (Hardwicke, Vicino, McBride & Nemeth, 1984; Moreno, Lee, & Sympson, 1985; Yoes & Hardwicke, 1984) to practical applications in education and other areas (McBride, 1985, Weiss, 1985, Weiss & Kingsbury, 1984). This research has concluded that computerized adaptive testing can be a successful alternative to printed tests--in educational, clinical, industrial and military settings. Computerized adaptive testing can reduce test length while maintaining measurement accuracy, and yielding immediate results.

However, to date there has been little research regarding students' and school administrators' reactions to computerized testing. The intent of this research is to examine factors which may limit the success of implementing computerized testing in the secondary school classroom. In comparison to paper-and-pencil testing, computerized testing is a novel experience to most students and to most test administrators. Many questions remain unanswered. For example, can students with no previous computer experience successfully take a computerized test? Is computer literacy a factor affecting test performance on the computer? Does gender impact test-taking on the computer? Are interactive instructional sequences suitable preparation for the computerized testing process? How do the administrative logistics differ from those for paper and pencil administration? What kind of problems, if any, are caused by the differences in administration? And what are the participants' overall reactions to computerized testing?

In short, this research effort explores participants' reactions to computerized testing and the practicability of this testing method in the classroom.

Method

Subjects

The students in this study were 315 students--161 girls, and 154 boys--in grades 8 through 12 and first-year college. They were residents of five states: California, Idaho, Missouri, Utah, and West Virginia. The students from Utah participated on a volunteer basis. All other students took part in the study mandatorily. Table 1 shows the grade and gender distribution of the sample.

Table 1
Sample distribution (Ns) by Gender by Grade

	Grade						
Gender	8	9	10	11	12	12+	Total
Boys	43	41	34	25	8	3	154
Girls	36	53	29	34	6	3	161
Total	79	94	63	59	14	6	315

The administrators responsible for planning and carrying out the test administrations were counselors, principals, and district testing directors who volunteered their organizations for participation in this study. Their incentive for participation in the study was the free test materials and test results, as well as a small catalog credit from The Psychological Corporation. There were two high schools, two junior highs, and one vocational/technical school in the study. The schools differed greatly in their size and type of surrounding community (rural and suburban).

Instruments

The Printed Test. The printed test used for this study was the Differential Aptitude Tests: Form W (DAT) (Bennett, Seashore, & Wesman, 1981). The DAT is a battery of eight subtests used in educational and vocational planning. It is designed for students in grades 8 through 12. The DAT is a timed test, requiring 3 hours and 45 minutes to administer. All items are multiple choice with two to five answer options. The titles of the subtests included in the battery and the length of each subtest are listed in Table 2.

The Computerized Test. The computerized test used for this study was the Computerized Adaptive Differential Aptitude Tests: Research Edition (CA/DAT) (The Psychological Corporation, 1985). (A final version of this test has since been published by The Psychological Corporation. It is called the Differential Aptitude Tests: Computerized Adaptive Edition, or the "DAT Adaptive.") The CA/DAT was untimed, taking roughly 2 hours to complete. It drew upon a pool of items taken from the DAT, Form V, a parallel form of the DAT, Form W. However, the CA/DAT administered only half the available items; item selection was done adaptively. Like the DAT, the CA/DAT consisted of multiple-choice items with two to five answer options. The CA/DAT could be administered only on Apple II series computers and compatibles. Two disk drives and at least 64K bytes of memory (RAM) were required.

Table 2
CA/DAT and DAT Subtests and Number of Items Administered

Test Name	Number of Items Administered in CA/DAT	Number of Items on DAT
Verbal Reasoning	25	50
Numeric Ability	20	40
Abstract Reasoning	23	45
Clerical Speed and Accuracy		
Part I	50	100
Part II	50	100
Mechanical Reasoning	35	70
Space Relations	30	60
Spelling	45	90
Language Usage	25	50

The Survey. The survey consisted of 19 questions: four demographic items, eleven multiple choice or short answer items and five free-response items. (See Appendix A for the text of the items on the survey.) Students' names were requested, but optional. Names were used to match survey responses to test results.

The survey was administered in traditional paper-and-pencil format. A draft of the survey was "tried out" by eighth and twelfth grade students; revisions were made based upon the results of the try-out.

The Testing Conditions Form. Test administrators at each site were asked to answer a brief set of free-response questions regarding the administrative logistics of the computerized testing sessions. The form encouraged written comments and phone calls to the authors of this paper.

Procedures

Of the 315 participants, 214 took the printed test prior to taking the computerized test. The remaining 101 students were tested in the reverse order. All students were required to take both tests as part of an equating and validation study.

Test administrators were given detailed instructions ahead of time regarding the administration of both the printed and the computerized tests. They were given suggestions and practical guidelines to use in planning and scheduling the testing sessions. The test administrators were responsible for the administration of the entire DAT battery (a total of almost 4 hours of testing time) and the computerized CA/DAT (approximately 90 minutes of testing time per examinee).

The printed test could be administered in large group sessions but the computerized test required that each examinee use a computer individually, so testing was done in smaller groups (depending on the availability of appropriate hardware). The (printed) DAT was administered according to the usual standardized testing procedures.

For the administration of the CA/DAT, local test administrators were responsible for starting the computer program and entering student identification information. Upon arrival, students were instructed to sit at the computer which had been prepared (started-up) for them. The first screen they viewed welcomed them to the computerized test, and began to explain how to use the computer to take the test. Test instructions were then presented interactively by the computer. Test administrators remained present to assist students having difficulty operating the computer during testing.

CA/DAT test items were presented on the screen one at at time. Students used only the Y and N keys to respond. Verification of each answer was required to prevent students from accidentally marking an unwanted answer.

Most computerized testing took place in classrooms, although some makeup tests were administered in an office. The number of computers used simultaneously in a classroom varied from 18 to 30. In office settings, only 2 to 4 computers were used simultaneously.

Whether they took the printed or the computerized test first, students were asked to complete the survey immediately after completing the computerized test.

Test administrators completed the Testing Conditions Forms after all students had been administered the CA/DAT.

Results

Student data were survey responses, computerized test scores and printed test scores. They are described as they pertain to the four areas below: (1) previous computer experience, (2) problems encountered during the computerized test, (3) positive reactions to the computerized test, and (4) comparisons between various groups in the sample. The students' results are followed by a brief description of the test administrators' reactions.

Previous Computer Experience

Although the students were not selected for previous computer experience, only 8.6% of the examinees were using a computer for the first time when they took the test. Of those students who <u>had</u> used computers, 84% had used them to play games, 70% had used them in a class, 32% had used computers at home, and 27% had written computer programs. Ten students (3%) said they had held jobs where they used computers. Many students had used computers for a variety of applications and settings, thus the percentages add up to more than 100%.

To assess whether previous computer experience affected computerized test performance, an Analysis of Variance was performed using a composite score from the computerized test as the dependent measure. The composite score, VRNA, is the sum of the Verbal Reasoning (VR) and the Numerical Ability (NA) subtests, and is a general indicator of scholastic potential. Table 3 displays the mean VRNA scores (Rasch ability estimates) for each of the categories of previous computer use. Although the means show a trend towards increasing scores with increasing prior computer use, the analysis indicated that the trend was not significant ($F = 1.74$, $df = 3$, $p > .10$). Less than 3% of the variance of VRNA was accounted for by previous computer use. The correlation between computerized VRNA and prior computer use was small ($r = .155$).

Table 3
Ns, Means, and Standard Deviations of Computerized VRNA Rasch Ability Estimates by Frequency of Prior Computer Use

Previous Computer Use	Computerized VRNA Scores N	Mean	sd
Never Used Before	18	-.56	2.21
Very Rarely Used Before	44	-.09	1.85
Occasionally Used Before	53	.28	2.30
Frequently Used	70	.55	2.07

Problems Encountered During the Computerized Test

Nearly half (49.5%) of the students reported that they experienced no problems during the computerized test. Of those who did report trouble, the major difficulty was with the computer screen: 63% said their eyes got tired during the test, 39% indicated that the screen was too bright, and 27.6% said there was glare on the screen. When asked specifically whether they had trouble using the 'Y' and 'N' keys to indicate their answers, 11.5% said they had "a little" or "a lot" of difficulty. Most student (88.5%), however, said they had no difficulty with the keys.

Two students (.6%) indicated that the online instructions for the test were very unclear. An additional 19% said they had to read the instructions more than once to fully understand them. The order in which the tests were administered significantly affected how well the students understood the instructions. Those who had previously taken the printed DAT thought that the instructions were clearer than those who had not yet taken the printed test (Chi Square = 7.1, $df = 2$, $p < .05$).

When asked in an open-ended question for the worst things about the test, students wrote that glare was a problem more often than any other response (32%). The second most common complaint was that there was no opportunity for students to review their answers (24%). The third most common response was that there were "no worst things" about the computerized test (22%).

Positive Reactions To The Computerized Test

When asked if they "liked" computers, no one in the study reported disliking them; examinees reported either liking computers "a lot" or "a little" (97%) or they neither liked nor disliked them (3%). Additionally, students were asked which test they would choose to take if they were given a choice between a computerized or a printed test. Ninety-one percent of the students indicated that they would choose a computerized test.

When asked if they felt more nervous or concerned because the test was on the computer instead of on paper, 85% indicated either that they were less nervous or felt the same. Only 3% indicated that they were much more nervous than they would be taking the test on paper, while 12% reported being "a little more nervous."

The most popular response for the "best things" about the computerized test involved the ease of answering (49%). Students appreciated not having to "bubble in" their answers on a scannable answer sheet. Other popular responses were that the test seemed faster (30%), it was untimed (25%), and the computerized test was "fun" (11%). Appendix B lists a representative selection of the comments made by students regarding the best and worst aspects of the computerized test.

Comparisons Between Boys and Girls

Two differences appeared between boys and girls in the study. Over half (51%) of the students reported no difference in the amount of nervousness they felt due to the computerized administration of the test. However, there was a significant difference between the boys and girls who did report more or less nervousness. Girls were somewhat more likely to report more nervousness than were boys--39% compared to 22% (Chi Square = 4.07, df = 1, $p < .05$). An analysis of variance indicated that the amount of nervousness reported did not significantly affect test performance as measured by the computerized composite VRNA score ($F = .326$, df = 4, $p > .20$).

Girls reported having a wider variety of problems than did boys: 45% of the girls versus 34% of the boys checked one or two different kinds of problems (e.g. glare on the screen, eye fatigue, screen too bright, etc.). Thirteen percent of the girls versus 8% of the boys reported three or more types of problems. Boys reported having "no trouble" 58% of the time while girls reported no trouble 42% of the time. This difference was significant (Chi Square = 8.59, df = 2, $p < .05$).

Boys and girls reported almost identical amounts of previous computer experience. Table 4 shows the Ns for boys and girls by the frequency of previous computer use. (Chi Square = .94, df = 3, p = .81)

Table 4
Ns of Gender by Frequency of Previous Computer Use

Previous Computer Use	Boys	Girls
Never Used Before	13	19
Very Rarely Used Before	38	39
Occasionally Used Before	45	46
Frequently Used	57	57

Administrators' Reactions

Administrators' reactions were assessed via the Testing Conditions Forms, telephone conversations, and written correspondence. Overall, comments regarding students' reactions were very positive. However, examiners reported several administrative details that could be eliminated or clarified for future examiners. Administrators' reactions are discussed in more detail in the following section.

Discussion

Students Reactions

The results of this study suggest that students do not need to be computer literate, or even to have previous computer experience to successfully take a computerized test. This finding is, of course, specific to the test used in this study. The CA/DAT was designed to be easy to use, and to not give "computer whiz kids" an advantage over the novice users.

Regardless of previous computer experience, students reacted favorably to the computerized testing. Some of the positive reactions, e.g. "the test was fun," may be a result of the comparative newness of the technology. In several years, when computerized testing is the norm and students are as familiar with computerized tests as they now are with printed tests, students may no longer think that a computerized test is any more fun than a printed test.

Other advantages will not change as computerized testing becomes more familiar to students. For example, eliminating the time-consuming and sometimes problematic task of filling in scannable answer sheets will be a lasting advantage of computerized testing. The shortened test length of computerized testing will also continue to be an advantage.

As the novelty of computerized testing vanishes, many of the problems associated with the new technology will also disappear. As students are raised on computers, computer-anxiety will become even less prevalent. Additionally, as students go through school taking computerized tests from a young age, they will

learn testing strategies different from the strategies students now use for printed tests. The inability to review answers (if this characteristic of computerized tests remains) will not be seen as a problem because students will learn to pick the best response the first time the item is presented and to not consider the problem a second time. Other test-wiseness issues will evolve as students become familiar and more comfortable with this mode of test administration.

The most common complaints from the students involved eye fatigue, glare on the screen, and screens which were too bright. These kinds of physical, technological problems are also likely to be solved with time. As the technology continues to improve and as schools continue to accumulate computerware, screens will be improved and/or schools may buy glare shield for their computer screens. To alleviate the problem of eye fatigue using currently available screens, text and graphics can be displayed in normal video rather than inverse video. Although the light-on-dark format is not what we are used to seeing on paper, the dark-on-light format (inverse video) seems to cause increased eye fatigue, especially when a large proportion of the screen is lighted.

Test Administrators' Reactions

Many of the suggestions, comments, and complaints from test coordinators involved the planning of the computerized test. They had difficulty scheduling large numbers of students to use a limited number of computers. This difficulty was handled in a variety of ways. One school rescheduled the computer lab for the duration of the testing; classes scheduled to use the computers were denied access while testing was in session. Each student was then scheduled for three 45-minute sessions on the computer.

Another school, which had a smaller number of computers, had a continuous flow of students coming in to the computer lab to take the test. Each student took the test in one sitting. Since the test was untimed, students finished at different rates. As a student left the lab, another was called to start the test.

The biggest problem to the test administrators was that the planning was novel to them. Each of them had, in the past, coordinated large and complicated standardized testing. This task included distribution and re-collecting scannable answer sheets, Number 2 pencils, and other test materials, sending it away to be scored, and many other administrative details. The computerized testing process was less complicated, but required more thought since it had not been previously proceduralized for them.

One of the features of the computerized adaptive testing most appreciated by the test administrators was the reduced testing time. Schools seem to be increasingly burdened by the time required to administer mandated tests. Since computerized adaptive testing requires that significantly fewer items be administered to each individual, testing time is reduced.

In general, this study suggests that computerized testing can be a viable alternative to traditional testing in the secondary schools. The availability of microcomputers is now the rule, rather than the exception, in the nation's

secondary schools. Testing situations vary so widely, it would be wrong to say that computerized testing can now replace printed testing altogether. However, the CA/DAT, one of the first tests of its kind to appear in the secondary schools, has broken ground for improved and expanded computerized adaptive testing in the near future.

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Appendix A: The Survey Questions

1. What grade are you in? (a) 8th (b) 9th (c) 10th (d) 11th (e)12th
2. What sex are you? (a)girl (b)boy
3. Write the name of the city and state in which you live.
4. Write the brand name of the computer monitor (screen) that you are using. If you are not sure, ask the teacher for help.
5. In November and December of 1985, you will take the Differential Aptitude Tests twice--once on paper and once on the computer. Have you already taken the paper-and-pencil version of the test? (a) yes (b) no
6. Overall, how clear were the instructions? (a) very clear, I had no problem understanding the instructions (b) somewhat unclear, I had to read them more than once (c) very unclear, I could not understand the instructions
7. Below is a list of things that may have caused you trouble during the test. If you had any trouble with the test, check the reasons below. Check as many as apply. If you had no trouble, mark the first one only. (a) I had no trouble (b) There was glare on the screen (c) The letters were not bright enough (d) The screen was too crowded (e) There was not enough space between the lines (f) The pictures on the screen were not understandable (g) The arrangement of the screens was confusing (h) My eyes got tired (i) The screen was too bright (j) Other: describe
8. Did you have difficulty using the 'Y' and 'N' keys to select your answers? (a) No, not at all (b) Yes, a little difficulty (c) Yes, a lot of difficulty
9. If you could take a test on the computer or on paper, which would you choose? (a) The test on paper (b) The test on the computer (c) Either one
10. Many students are a little nervous or concerned when they have to take a test. Do you think you were more nervous or concerned because the test was on the computer rather than on paper? (a) Yes, I was much more nervous (b) Yes, I was a little more nervous (c) No difference (d) No, I was less nervous (e) No, I was much less nervous
11. How often have you used a computer before taking this test? (a) Never (b) Very rarely (c) Occasionally (d) Frequently
12. Write the number of years and months you have been using computers. If you have not used computers, write "None."
13. Describe how you have used computers. Check as many as apply. If you have never used a computer mark the first one only. (a) I have never used a computer (b) I have played games on the computer (c) I am currently taking my first computer class (d) I have completed one computer class or short course (e) I have completed more than one computer class or short course (f) I have written computer programs (g) I have used a computer at home (h) I have used a computer in class (i) I have used a friend's home computer (j) My parents taught me to use computers (k) I have held a job where I worked on computers (l) Other: describe
14. Do you like using computers? (a) I like them a lot (b) I like them a little (c) I neither like nor dislike computers (d) I dislike them a little (e) I dislike them a lot
15. What are the best things about taking the test on the computer?
16. What are the worst things about taking the test on the computer?
17. What would you change about taking the computerized test?
18. What was your overall reaction to taking a test on the computer?
19. Use the space below to write any other comments you have.

Appendix B: Excerpts from Student Surveys

1. What are the best things about taking the test on the computer?

All you have to do is push buttons on a computer and on paper you gotta grid in circles.

No waiting Faster It's not as long

It's quicker Funner I was less nervous.

It was fun

you just push 2 buttons

You don't have a cramp in your HAND

you don't have to fill in circles

your hands do not get that tired. You have MORE TIME to think things over than on written test

See everything before you, goes quickly, quick response a fresh approach to paper + pencil - ease in correcting

That you can't be mistaken it's a dealt

2. What are the worst things about taking the test on the computer?

I don't see anything bad about taking the test on computer,

The mathematical numbers such as 2 3/4
read like this 2 3/4. That took a little
time to figure out.

your eyes beem tired after awhile

bright monitor, akward keys, the disk drive
did a lot of annoying "knocking", small, rolling table,
green monitor (ick!), radiation

You can not go backand
check your answers.

Some of the pictures aren't as sharp as they would be on paper.

There is a glare.

My eyes got tired!

Screen was to bright

Bar Foid Apple IIe Trash!!!

you can't go back and redo it.

My contacts start to bother me.